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PEACH YELLOWS AND LITTLE PEACH

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SUMMARY

Yellows and Little Peach cause great losses in Pennsylvania's 4,800,000 peach trees, not only by the actual destruction of trees but by shortening the profitable bearing life of orchards.

Although the cause of these diseases is unknown, they are known to be transmissible.

Seeds from diseased trees germinate in only a small percentage of cases, and seedlings from such seeds may not be diseased.

Nursery stock is readily infected by budding from diseased trees and since the disease symptoms may not appear in young trees for several years, nursery stock is regarded as a very possible means of spread.

These diseases spread in the orchard though the means of spread and the time of year when it takes place are unknown.

The spread of disease by dormant pruning is doubtful.

There is no evidence to show that pollen distribution is a factor in spread.

Soil transmission is not considered probable from the fact that replants to replace Yellows trees are not particularly subject to infection.

Trees affected by Yellows and Little Peach have never been known to recover.

The only cheap, sure, and effective method of controlling Yellows and Little Peach is to remove all diseased trees as soon as they show the first signs of disease.

The promptness of removal is all important.

Inspection for Yellows and Little Peach can be given profitably (a) just before blooming, (b) about July 1, (c) a week or ten days before the fruit ripens, and (d) in late summer.

The state has maintained an annual inspection for Yellows and Little Peach in the southeastern peach counties since 1921, covering approximately 500,000 trees in over 400 commercial orchards in fourteen counties. Inspection records show a definite decrease in yellows in this area, from 4.5% in 1921 to 2.5% in 1922, and to 2.21% in 1923.

The Department inspectors visit these orchards in summer and blaze trees, after which such trees are removed by the owner.

To supplement this inspection and to ensure removal of diseased trees as soon as symptoms appear, every peach grower is urged to be his own inspector.

PEACH YELLOWS AND LITTLE PEACH.

W. A. McCubbin

There are three peach troubles of major importance in Pennsylvania peach orchards,—Peach Tree Borer, Brown Rot, and Yellows. The borer problem has been solved by the introduction of PDB (paradichlorobenzene), and Brown Rot can be controlled by spraying. The experience of years shows that Yellows and Little Peach can also be controlled as set forth below.

Yellows Raises the Cost of Production

The damage done by yellows is not fully appreciated. A peach is at best a short-lived tree which must pay by a few crops during its maturity for the early expense and time necessary to bring it into bearing. As inspection results indicate, Yellows does not become pronounced until about bearing age; consquently replacement is not needed until the expense of bringing the trees to bearing age is already incurred. On the other hand replacement is not profitable after a few seasons of bearing since the new trees will not produce much before the rest of the orchard is too old. If replacement for Yellows could be made earlier or continued later losses from Yellows would not be so severe. As it is the big loss from Yellows is not alone in the trees actually destroyed or rendered worthless, but in a shortening of the bearing life of the orchard, since after a certain percentage of trees go out with Yellows the orchard as a whole is no longer profitable and must all be cut down. If Yellows can be reduced to such a degree that the orchard can add a few more years to what is admittedly the most profitable portion of its bearing period, much will have been accomplished in lowering the production cost of peaches in the state.

History of Yellows

Peach Yellows is not a new disease. Old records indicate its presence in the Philadelphia region about 130 years ago. Since then it has been troublesome in most of the eastern peach sections, varying in intensity in various localities and at different periods of time.

Little Peach may be equally ancient but it is only a matter of thirty years since it has been recognized as a distinct type of disease.

It also varies for time and locality as does Yellows, and it is well-known that the relative importance of the two diseases may differ greatly; in one section of the country there may be much Little Peach and little Yellows, while in another district Yellows predominates; in a few years' time the conditions may be entirely reversed, the first section showing an increase of Yellows and a decrease of Little Peach, while in the second district Little Peach has become important and Yellows has become relatively less.

There has also been noted a rise and fall of intensity in Yellows, the disease assuming the nature of an epidemic every ten or fifteen years, with quiescent periods intervening between the periods of excessive virulence.

NATURE OF YELLOWS AND LITTLE PEACH

It has been recognized for some time that both these troubles apparently fall into the class of diseases known as the "Mosaic" group which includes a large and ever-growing number of such maladies as Potato Leaf Roll, Raspberry Leaf Curl, and the numerous Mosaic diseases affecting potato, bean, tomato, tobacco, raspberry, cucumber, and other wild and cultivated plants. All these troubles have been called "virus" diseases on account of the fact that the sap or juice from a diseased plant will in most cases transmit the disease to a healthy one, and that no organism has yet been clearly associated with them. Forty years ago the sickly appearance of Yellows peach trees was thought to be associated with fertilizer or soil conditions and extensive experiments were carried out to locate the soil factors which might be responsible. Applications were made to the soil of a vast number of fertilizers and chemicals in various amounts and in different combinations, but without result from the standpoint of control.

Later on an attempt was made to explain Yellows and related troubles by means of the enzyme theory which was based on the idea that certain necessary ferments in the tissues had undergone a permanent change in their chemical constitution and were no longer able to function properly. This theory was never widely accepted, and has now almost disappeared. As a consequence of the studies made during the last few years on various important diseases of the Mosaic type, plant pathologists are rapidly coming to the conclusion that these troubles are due to organisms of some kind, and every effort is being made to find these.

While a knowledge of the exact cause would no doubt make some difference in our treatment of Yellows it is almost safe to predict that even if the cause were known our present method of control by removing diseased Yellows trees will not be affected; it is probable that the finding of a causal organism would help us most by showing the method of spread and thus enabling us to take steps to prevent infection.

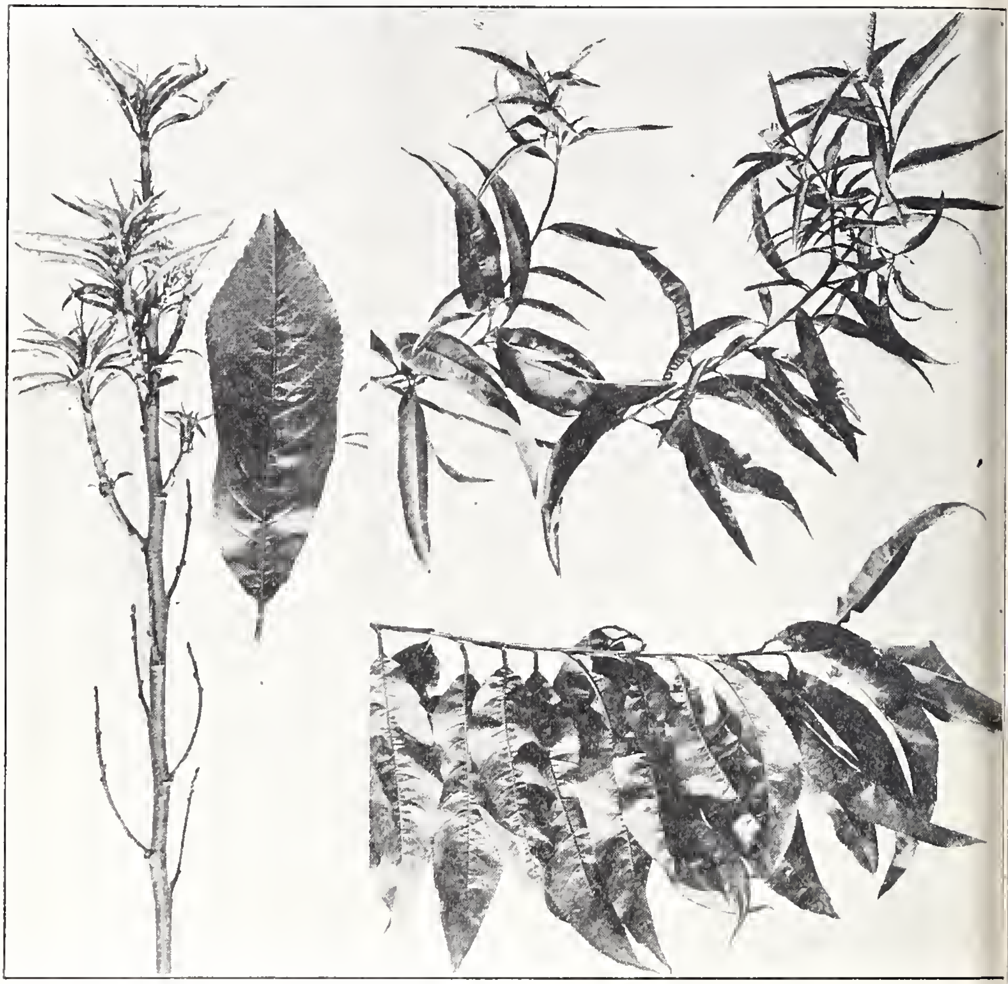

Fig. 1. Left, a typical "willow" shoot showing the upright, much branched habit with small yellow foliage. A normal leaf is given for comparison. Right, terminal shoots, the lower healthy and the upper showing sickly, slender terminals with a strong tendency to grow upward.

SYMPTOMS OF YELLOWS

In bearing trees one of the first as well as one of the most reliable symtoms of Yellows is the premature ripening of the fruit, which may color and soften from a few days to three weeks before its time. Such fruit is usually though not always, abnormally large; it is insipid in taste, usually more watery in texture and rots readily; the skin of premature fruit is often speckled or blotched with red. These skin spots are quite different from any streaks or other natural coloring of the peach and when present on premature fruit give additional assurance of Yellows. The Elberta variety does not show much blotching on its prematures as a rule. Associated with these surface blotches such fruit will usually show red streaks in the flesh and prominent reddish discolorations in the flesh around the pit. The amount of color may vary from almost none at all to a condition where the whole flesh becomes a deep red. It is well to note that in certain varieties the flesh of normal fruit is tinged with red. This character is not constant therefore and is not alone a reliable indication of the presence or absence of Yellows; on the other hand it is very helpful in cases where it can be contrasted with normal fruit and where prematurity is not pronounced.

To sum up characters of Yellows in the fruit it may be said that large size, blotched skin, lack of flavor, and discolored flesh are not invariably present, but that premature ripening of the fruit is in it self a sure indication of the disease. Premature fruit in early stages is usually found on only a single limb, or in a few fruits on a branch, or even in extreme cases only a single peach on the tree is premature. Cases of the other extreme where all the fruit is premature are plentiful and cases where only one small branch ripens normally are not uncommon. The certainty with which one can depend on premature ripening as a sure symptom of Yellows emphasizes the value of inspection in the period just before ripening takes place.

Of equal value in determining Yellows is the presence of the so-called "willow" shoots or "broom" shoots (Figs. 1 & 2.) These can always be distinguished from ordinary twigs and water shoots by their slenderness, by the fact that they tend to branch repeatedly, and by their small yellow foliage, which is often spotted with red. Another outstanding character of these shoots is their tendency to grow upright. A healthy twig starting from the lower side of a branch grows outward at a wide angle but the Yellows shoots in such cases have a strong tendency to curve around the branch and grow straight upward. This same tendency is seen in Yellows shoots on the terminals of branches; instead of continuing the growth of the branch they curve upward in characteristic fashion.

The branching of Yellows twigs is also outstanding. A vigorous water shoot will branch to some extent but the side shoots in that case are pointed outward, while the branches on willow shoots tend to grow more definitely upward.

These characteristic willow shoots may arise from any part of the main limbs, or they may be terminal (Fig. 1.) For the most part they are to be looked for on the larger limbs. Willow shoots are regarded as being associated with later stages of the disease but their occurrence is irregular. They can be found with a few premature fruits on a single limb, or even in trees on which no prematures can be found. On the other hand trees with practically all fruits outstandingly premature may have no sign of willow growth. In most cases they are likely to develop late in the season, which is a good reason for giving any orchard a late summer inspection.

These abnormal shoots even if they are so small as to be readily overlooked are regarded as a sure symptom of Yellows at any time of the year, and there need be no hesitation in marking any tree in which this feature is present.

Closely following and often associated with premature ripening are the foliage symptoms from which Yellows derives its name. The typical symptoms on the leaves varies for different types of foliage, such as are exhibited by the Elberta on the one hand and the Crawford on the other; allowing for these differences the general foliage symptoms are very similar.

The very earliest symptom which can be noted is an unhealthy yellowing of the foliage, which can often be distinguished at a distance especially if only one branch of a tree is affected. In other words the foliage is off color. As time goes on this yellowish tint becomes pronounced and there is a strong tendency for the foliage to droop as if it lacked water. Later still, or in the second season, the yellowish leaves show a claw-like curling which gives the leaves on a shoot a bunched effect. This is followed by a stage of sparse, small, yellowish foliage on short twigs. The next stage is death of the twig.

The yellowish color, small size, drooping and curling habit, and short twig growth here mentioned are so similar to the effects produced by other causes such as drought, borers, mechanical injury or starvation that it is sometimes difficult to determine Yellows with certainty from foliage symptoms alone. On the other hand the necessity for making determinations from foliage when there is no fruit, before or after the fruit ripens, and especially in young orchards, is apparent and every effort should be made to distinguish the disease by its foliage characters.

It has long been observed that a Yellows tree will set its buds earlier in fall and that these will be larger and more developed when winter comes; and that in spring both leaf and blossom buds start quicker than those of healthy trees, often blooming several days in advance of the rest. One can see this in exhibited striking manner where a single branch is diseased; this branch will be in full bloom while the remainder of the tree still has its fruit buds unopened. It is possible that this character could be used to some extent as an additional help in detecting the disease.

SYMPTOMS OF LITTLE PEACH

The characteristic of this disease as the name implies is the small size of the fruit which ripens later than usual. Apparently the lateness of ripening and decrease of size differ according to the severity or stage of the disease, varying from nearly normal sized fruit ripening almost on time to very small fruit maturing ten days or more later than normal. Little Peaches have neither the blotched skin nor the discolored flesh characteristics of Yellows and their flavor is not altered so markedly.

The disease may start in one limb as does Yellows, and gradually involve the whole tree, but willow growth seldom occurs in connection with it.

Foliage symptoms are somewhat similar to Yellows, but there is a marked curling and clustering of the yellowish leaves at much earlier stages. It is stated also that in the early stages of Little Peach the terminal leaves on a shoot will remain for some time normal in color, especially in Elbertas, thus showing considerable contrast with the yellow clustered foliage below.

In early stages this clustering or curling downward is most likely to be prominent in the central shaded portion of the tree.

In both Yellows and Little Peach the foliage symptoms are so similar under some conditions that there is difficulty in distinguishing between them. This is not an important matter since the ax would be used in either case. It is of more concern to the peach grower to be able to distinguish these diseases from other troubles such as the effect of winter injury, the work of borers, and the starved yellow foliage resulting from lack of fertilization or cultivation. It is well recognized that these diseases can be best determined in a flourishing and well-kept orchard, where their symptoms stand out clearly in contrast to the normal healthy tree. Orchards in which the abnormal conditions mentioned exist require much care and study to separate out these diseases from the less important troubles with which they may be confused. It becomes largely a matter of eliminating all other causes which could produce the symptoms.

OTHER TROUBLES LIKELY TO BE MISTAKEN FOR YELLOWS AND LITTLE PEACH

It has been pointed out that the symptoms of Yellows are of the nature of an obstruction of the movement of food materials from the leaves downward,—in other words a girdling effect. For this reason any type of girdling is likely to produce symptoms similar to those of Yellows. Label wires, mice, rabbits, borers, and cankers or injuries on the limbs will in certain cases cause foliage conditions difficult to distinguish from true Yellows.

A form of injury due to killing of rootlets and root hairs results in a rolling, yellowing and falling of the leaves and resembles the effect of a sudden and severe drought.

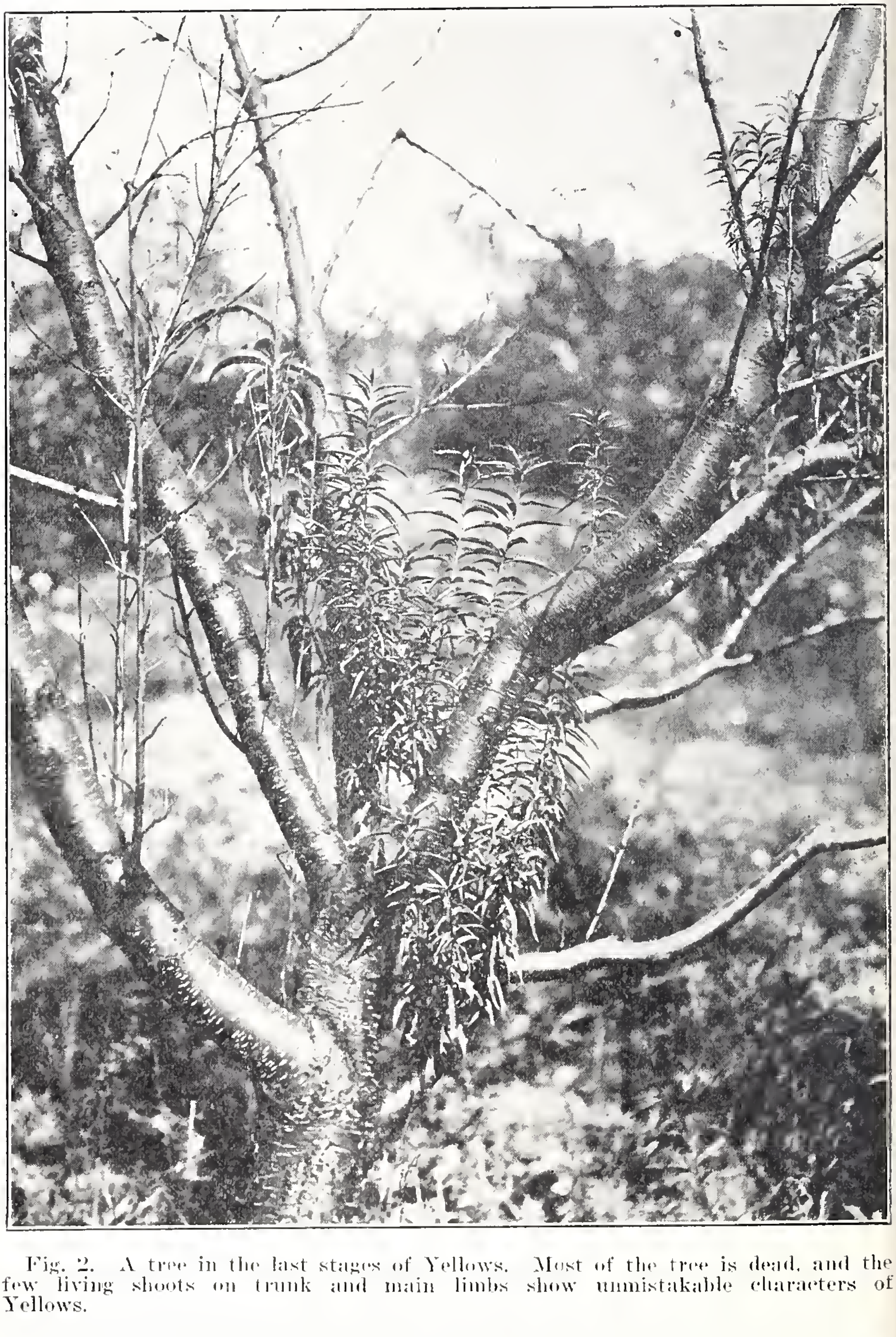

Fig. 2. A tree in the last stages of Yellows. Most of the tree is dead, and the few living shoots on trunk and main limbs show unmistakable characters of Yellows.

Some varieties of peaches such as the Smock have normally a more yellowish tinge in their foliage than the varieties with dark green leaves. Unless this difference is recognized trees of these varieties may be unjustly under suspicion.

Starved and neglected orchards where weeds are abundant and no cultivation is given will develop foliage characters difficult to distinguish from Yellows.

Other causes may bring about early ripening of the fruit, such as limb injuries, girdling, borers and drought. Fruit has often been seen with one side well colored and soft while the other side and the rest of the fruit is still green. Examination will show that mechanical pressure due to expansion has ruptured the connection on one side of the fruit pedicel, and the side thus cut off from food has ripened prematurely.

There are also unusual cases where the blotched condition of the fruit may have resulted from winter injury and not from Yellows. Similarly the pronounced red discoloration of the flesh especially around the pit, while not a normal character in Elberta and similar varieties, is more or less present normally in some other varieties.

Buttons or small undeveloped fruits which might be mistaken for Little Peach symptoms occur here and there among all varieties and are especially abundant on the J. H. Hale. The smaller fruit on many seedling trees is so common that it scarcely needs mention.

"Willow" growth so reliable an indication of Yellows is small, much branched, upright in character and bears smaller yellowish leaves. It should not be confused with water shoots growing around pruning wounds and weak shaded shoots in the center of a vigorous tree. Where twig growth has received a midsummer check and then resumed growth the subsequent growth is likely to have foliage that by contrast appears smaller and more yellowish, but is without the other characters of true Yellows twigs.

HOW YELLOWS IS SPREAD

Very little is known regarding the time and methods of spread of Yellows and Little Peach. The general conclusions reached have been obtained from observations and experiments and in some cases the evidence is supported by the behavior of supposedly similar diseases in other plants.

Opinions differ as to whether these diseases can be transmitted through the seed. Some authorities state that it does so, while others record no disease developing in seedlings derived from diseased seeds. In addition to tests made by others on this point the writer planted 1200 pits from badly diseased trees. 8% of these germinated and the resulting seedlings showed no disease after four years. New Jersey experiments gave a similar result.

This point is of concern to the nursery industry since it would be possible in this way to introduce the disease into the stocks used for budding. But even if Yellows was seed borne in certain cases such a small percentage of seeds from Yellows trees will grow that it is unprofitable to use them for nursery seedling stock and for this reason as well as from a desire to provide clean stock the best nurserymen use pits from the natural peach trees obtained from Tennessee and elsewhere in the south in a region free from Yellows.

When one comes to consider the possibility of spread by budding from diseased stock there does not seem to be such assurance of protection. Buds from diseased trees have been long known to transmit the disease and there is strong suspicion among peach growers that their Yellows troubles come by way of the nursery stock. During 1922 and 23 the Yellows inspectors were asked to make special note of Yellows occurring in young orchards and to find out in such cases the origin of the stock. If a young orchard develops a great amount of Yellows suddenly it would seem fair to suspect the nursery; or if a number of young orchards planted from the same nursery stock showed the disease in their early years the nursery would likewise be under suspicion. Up to date our records do not provide evidence in either way which would cast suspicion on any nursery, and in most of the cases where Yellows appeared in young peach orchards there was every reason to connect the outbreak with old diseased trees near by.

Nursery methods of budding either from adjacent young stock or from old trees elsewhere may at times fail to provide adequate safeguards against infection of their stock and it is urged that more care be given to establishing the freedom of budding stock from Yellows and Little Peach.

Does one spread Yellows by pruning operations? It seems logical to suppose that a disease which can be spread by budding or grafting could also be spread by pruning tools. Here again we can only fall back on long observation. If Yellows is spread by pruning, the orderly row by row method in which this is usually done ought to result in spreading infection down the row from a diseased tree. No one has recorded cases of this kind and it seems as if we can disregard pruning as a means of spreading Yellows. This refers to pruning in the dormant state; peach trees are so rarely pruned in summer that there is no body of evidence to show whether or not summer pruning would be dangerous.

The question as to when the disease spreads most in summer can not be answered. Orchard infection appears to be of two types, in one of which the disease appears in isolated trees anywhere in the orchard as if it had come from a distance, and a second type where the disease undoubtedly spreads from a Yellows tree to trees in its immediate vicinity. This last type of spread is clearly established by countless observations though what agencies are concerned can only be guessed at. Ordinarily the spread from a diseased tree is roughly in the form of a circle, sometimes leaving trees close by and taking those further out; but occasionally the spread has a streak shape which suggests that the wind might have had something to do with it. Bees which spread pear blight so readily, and the pollen which may be distributed by wind as well as by bees have long been considered as possible agents of transmission, but suspicions as to their activity have never been confirmed by experimental evidence. On the other hand observations made in New Jersey indicated that pollen taken from a diseased tree in breeding work did not cause any disease in the trees on which it was used. Judging from the part played by sucking insects in other diseases such as beet curly top, potato mosaic and raspberry mosaic, it is not at all improbable that some of these insects may also be concerned in Yellows transmission, and if the nature of Yellows is comparable to many others supposedly of like type it is also not impossible that the disease may occur in some other wild or cultivated plant with some insect as a carrier between it and the peach.

A question of considerable importance to some orchardists is how far the disease will spread from a neighboring lot of diseased trees. It is probable that Yellows can be carried from one orchard to another for a mile or more but it is the writer's opinion that spread from this distance is likely to cause only isolated cases which can be readily suppressed by prompt removal. If the diseased orchard is close enough however, the second type of spread mentioned above undoubtedly takes place; and since this immediate localized infection is extremely virulent in most cases, the owner of a healthy orchard has every right to expect protection from his neighbor's diseased trees. As to the distance that should intervene in such cases so that the owner of healthy stock is not menaced, opinions differ, but it is probably safe to assume that an orchard more than 300 yards distant from another will be subject only to the first type of spread.

CONTROL OF YELLOWS AND LITTLE PEACH

While Yellows and little peach differ in appearance the control of both is identical and may be summed up in four words: "Use the ax promptly."

There is no other way. All over the country, year after year, generation after generation, peach growers without number have tried to avoid the loss of the tree by this method and that; one cuts off the limb on which Yellows first appears; it does not save the tree; another fertilizes heavily and gets a growth stimulation for a season, but the apparent recovery is only an illusion and the disease pursues its inevitable course; a third cuts off all the top leaving only a few bare limbs. The new growth from this "dehorned" tree is usually more vigorous than before and for one season he entertains the false hope that the Yellows has been eliminated. Then comes the certain disappointment when the tree goes the way of all the rest. Neither these attempts nor the multitude of quack sprays, nor applications of special substances, nor insertions of chemicals in auger holes in the trunk have ever given the least success. In short *no tree affected by Yellows and Little Peach has ever been known to recover,* and the sooner we accept this result of widespread and dearly bought experience the sooner will we come to depend on the only safe, cheap, practical and effective method of controlling Yellows,—the ax.

When should diseased trees be cut down? Since we know that Yellows spreads from tree to tree though we cannot say how or when, the tree is a danger to the rest as long as it remains in the orchard. A Yellows tree in a peach orchard is as much a danger to the other trees as a hog with cholera, or a cow with tuberculosis is to the healthy animals in the herd. For this reason the affected tree should be removed as soon as the disease shows itself. It should be borne in mind that because of our ignorance of the cause and spread we can not say how long the disease has been present before visible symptoms appear; hence in order to minimize the chance of spread to the lowest possible degree diseased trees should be removed at the first sign of Yellows. Experience has shown that when trees are removed in these early stages the disease can be controlled.

It is not considered necessary to remove the whole tree immediately from the orchard. Some authorities are even against doing so on account of the possibility of infecting healthy trees by dragging the diseased branches and trees so as to bruise or scrape the healthy ones. At any rate experience has shown that the safe as well as practical method is to cut off all branches close to the trunk and pile them there till they wilt and dry. The branches can then be taken out and burned or used for fuel and the stumps can be pulled or dug out in the least busy season of the year. One precaution is necessary if this method is followed; very often water shoots will start from the bare trunk or limbs and these are considered to be as great a source of danger as the foliage of the tree in its original state

The question is often asked: "Is it safe to replant a peach tree in the spot from which a Yellows tree has been taken?" The general consensus of opinion is that this replanting is safe especially if the hole is left open over winter. This does not necessarily mean that the new tree will not contract the disease but it does mean that such a tree will be no more subject to infection than other trees in the orchard.

THE PEACH GROWER'S OWN INSPECTION

While the successful peach grower will be always on the watch for Yellows and Little Peach, there are four times during the summer when a systematic inspection will give the best results. The first is at the blooming period, when it is possible to find out by the symptom of early blossoming, which trees may be suspected of Yellows. The second survey should be made about July 1, and this will often disclose marked cases of disease on foliage and twigs. The third is the all-important inspection made about ten days before the fruit begins to ripen; at this time the premature fruit will give reliable evidence as to the presence of Yellows. A fourth inspection in late summer will usually settle doubtful cases since outstanding foliage symptoms or pronounced willow twigs often develop after picking time.,

STATE INSPECTION FOR YELLOWS

In 1920 a preliminary survey of the southeastern counties showed so much Yellows that some system of general inspection seemed to be necessary. A canvass of the other peach growing states indicated the desirability of this work being undertaken by the state, and the Penna. Horticultural Association having expressed accordance with a program of this kind, Yellows inspection was put into effect in 1921. This inspection is carried out under the Horticultural Inspection Act of 1917 (No. 236) which empowers the department through its inspectors to enter any premises for disease inspection purposes. Where an incurable disease is found the owner is so notified in writing and the law stipulates that if the affected trees are not removed within ten days the owner is subject to fine and the department may remove the diseased trees and recover the cost of removal from the owner or property. Up to the present time the cooperation of peach growers has been such that recourse to the penalties of this law has been found unnecessary.

That the inspection is fulfilling its purpose is indicated by the inspection records since inspection was instituted in 1921. In that year the inspectors of the Department of Agriculture inspected nearly half a million trees and found 4.5% of Yellows. In 1922 Yellows had diminished to 2.5% and in 1923 to 2.21%.

The inspection service is organized by counties and aims to cover in these counties all orchards of a commercial value, leaving out of consideration as yet the small lots of trees found everywhere in farm, village and town gardens. It is aimed to give two inspections each summer, one beginning July 1 and the other Sept. 1. Each inspector is armed with a small ax and he goes over each orchard row by row blazing every tree which shows symptoms of Yellows or Little Peach. The marks thus made are a clear indication of the disease to the owner and since the blaze is a more permanent mark than paint, cloth strips, or broken down branches, it serves to check up on trees that may have been overlooked in removal. This inspection is understood to be merely a help to the peach grower's own eradication program, and it is strongly urged that every man should be as far as possible his own inspector. In this way he can catch the disease and destroy the tree as soon as the earliest symptoms appear, and thus secure the benefit of the most important factor in Yellows' control,—promptness in removal.